

Bo VST Report 02/27/13

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Contents:

- Condenser
- Monitors and Analytics
- GQE Progress
- N₂ Absorption Measurement

- Condenser working stably without intervention for ~1week.
- Has ice to prove it!
- Argon pressure maintained at 10 ± 0.2 psig

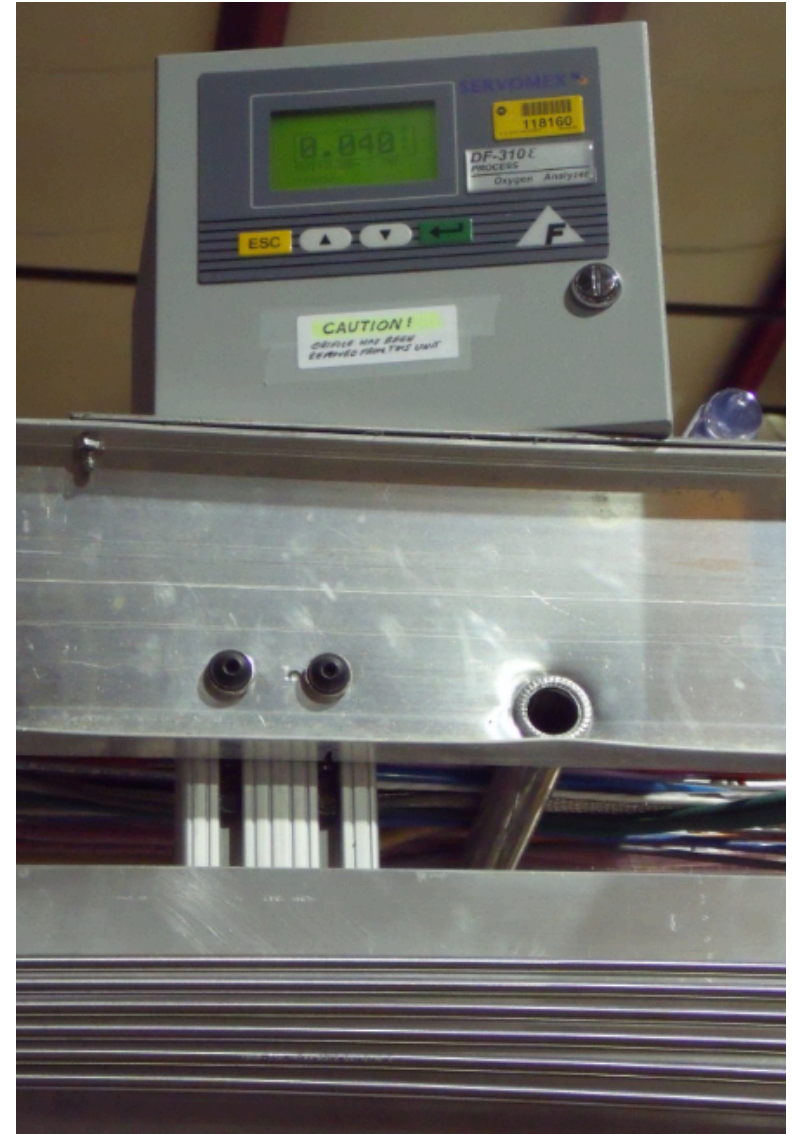


N2 Monitors

- We have borrowed the MicroBooNE N2 monitor and can have it for ~3 months.
- More sensitively pre-calibrated than previous N2 monitor, for a span of 0-5000ppb with 10ppb precision.
- This means that outside this span we can't measure without either:
 - a) recalibrating the uBooNE system (don't recommend)
 - b) swapping back to JongHee monitor (currently favored)
- I have performed this swap once. Both read consistent values at the swap point :
 - uB : 3060ppb, JH: 3.1ppm
- For non N2 injection studies, uB monitor is ample for impurity monitoring.

O2 Monitors

- O2 monitor is working stably after a ~4 day stabilization period.
- O2 concentration in Bo is stable at 40ppb (read from the gas line)
- I have not yet done the calculation to work out what this corresponds to in the liquid.
- But it is small enough that we don't need to worry about O2 in this fill.



H2O Monitor

- Also borrowed the uBooNE H2O monitor (we now have 50% of the MicroBooNE analytics rack!)
- Plumbing today. Some negotiation to be done so as not to interfere with Luke H2O sampling scheme.
- Should be able to measure water concentration (and get a handle on outgassing) in the next few days.



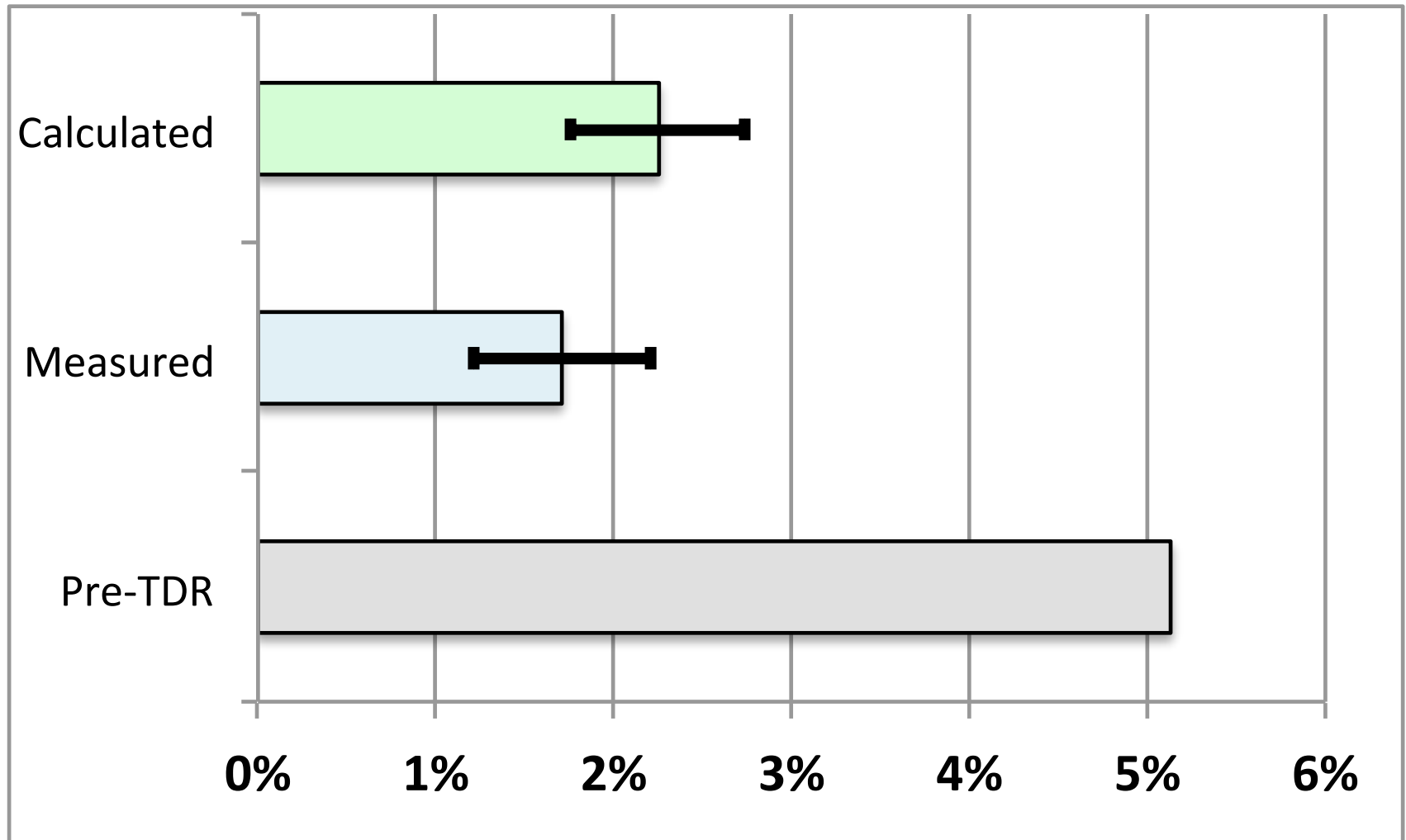
Light yield used to extract measured GQE:

Light yield prediction for Bo					
	Value	Uncertainty	Int Step	Source	Uncertainty Comment
210Po Alpha Energy (MeV)	5	0.3	0.0036	From MIT range straggling studies	
Ideal Scint Yield (photons / MeV)	51000	1000	0.00038	Doke et al, NIM A Volume 269, Issue 1, 291–296	Spread of values given in paper
				Doke et al, NIM A Volume 269, Issue 1, 291–296	
dEdx Quenching for alpha	0.71	0.02	0.00079	ICARUS NIM	Error bar from yield vs LET plot
Prompt light for alpha	0.565	0.005	7.8E-05	Calculated accounting for well geometry and source distribution	Number of significant figures given
Fractional Solid Angle	0.029	0.008	0.0761	Calculated 0.71 in worse case, and assume some "helpful scattering"	Variation between extreme source deposition distributions
Rayleigh Scattering losses	0.75	0.05	0.00444		71% is worst case, add on 5-15% for helpful scatters
Average Photons / Alpha:	2224.878188	650.184635			

Calculation used to estimate what we expect GQE to be from known data:

GQE Estimate					
	Our Estimate	Uncertainty	Int step	Source	Uncertainty comment
TPB photons out / in (evap)	1.18	0.1	0.00718	Gehman et al, arXiv:1104.3259	Error bar from paper
TPB-PS vs Evap TPB	0.64	0.11	0.02954	Christina vacuum spec measurements	Error bar from Christina
Forward vs backward emission	0.5	0	0	Fixed at 50%	No uncertainty
				Averaged Hamamatsu QE over TPB	
Tube QE	0.199	0.002	0.0001	emission spectrum	Plot digitization error (no error bar given)
Acceptance of light from plate	0.3	0.03	0.01	Ray tracing MC, Jones + Touns	Discrepancy between MC outputs
Total GQE:	0.02254272	0.00487798			

Current Status of GQE



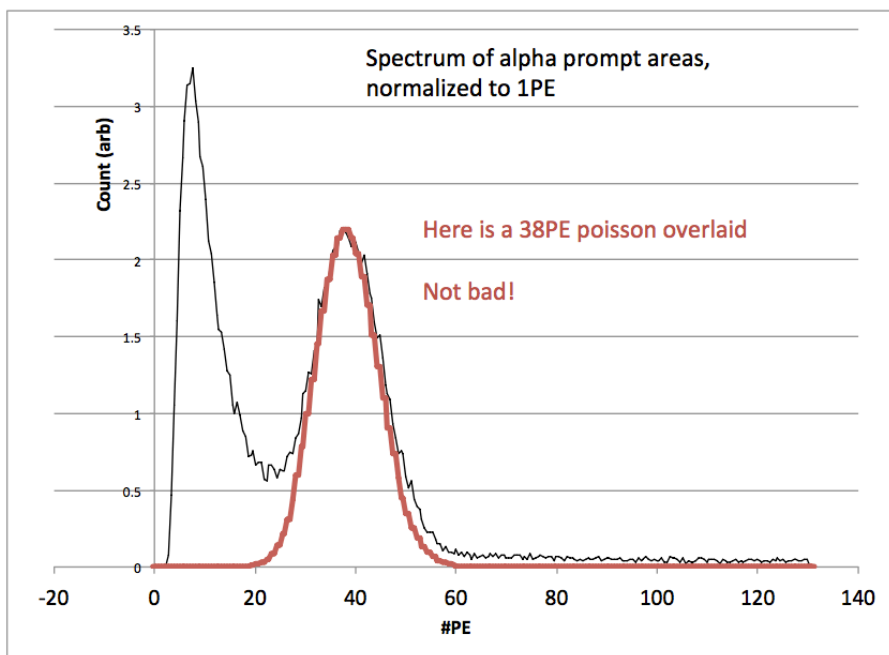
But, key point:

- We see 5MeV alpha at 40cm with 38PE.
- Our baseline goal is to see 40MeV everywhere in the detector. Clearly this is going to be fine.
- Our stretch goal is to have good efficiency for 5MeV tracks.
- If we get 38PE at 40cm from a 5MeV alpha, we can clearly see them easily in some parts of the detector
- More detailed study now being done to turn what we learned in Bo in uB sensitivity numbers / fiducial volumes for 5MeV detection.

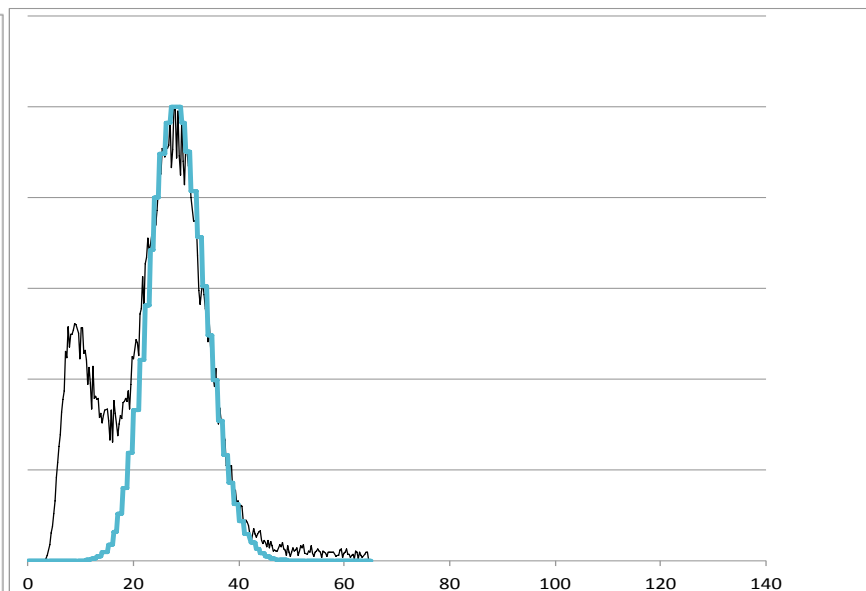
Something we don't understand:

- Last week I showed a beautiful 38PE poisson, obtained after a fresh fill
- Returning a week later, I have a beautiful 28PE poisson.
- The reason for the discrepancy is not understood.
 - Outgassing water? Hydrocarbons from feedthrough? Alpha source too close to VL boundary?
- All being actively investigated.
- We have also adjusted the Bo schedule to add purity and outgassing related tests.

Last week



This week



* Ignore low energy tail – the triggers are in different places, so don't expect this to look the same.

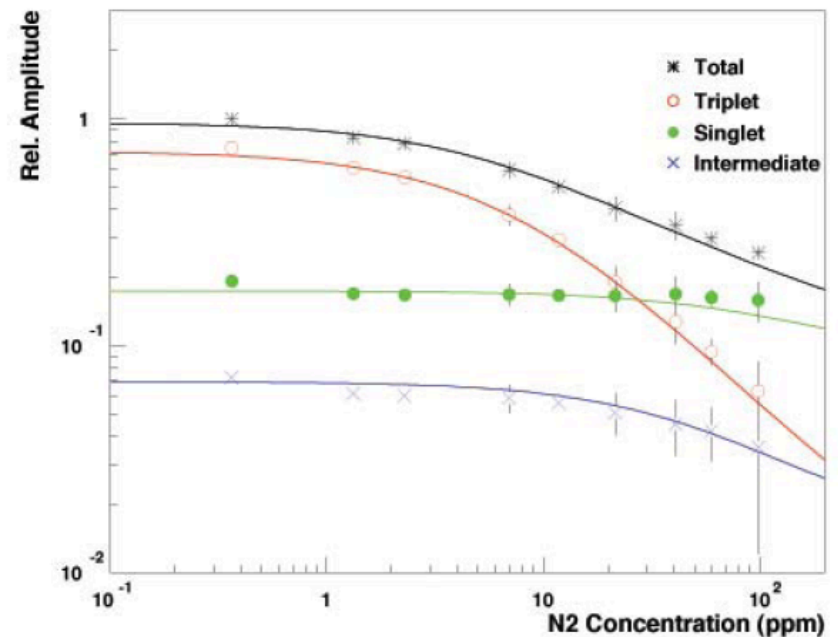
Stable, for now

- Distribution now appears stable.
- For N2 measurements I took the same dataset twice to check for drift over ~9 hours between last evening and first morning measurements each day
- You will see these on the upcoming plots – and note that variation between them is much smaller than variation between other data points assumed to be from N2 effects, taken 2-3 hours apart.

N2 Absorption

- As well as quenching (affecting time constants + amplitudes we expect to see absorption from N2 in argon.
- Random numbers get quoted (last one I heard was 1% per cm for 0.3ppm N2. This is a HUGE effect and we would see it easily)
- By repeating the same study with the source in 2 positions, we can separate the effects of quenching from absorption.
- So far I have taken the first of the two datasets – already enough to rule out N2 absorption at the level quoted above.

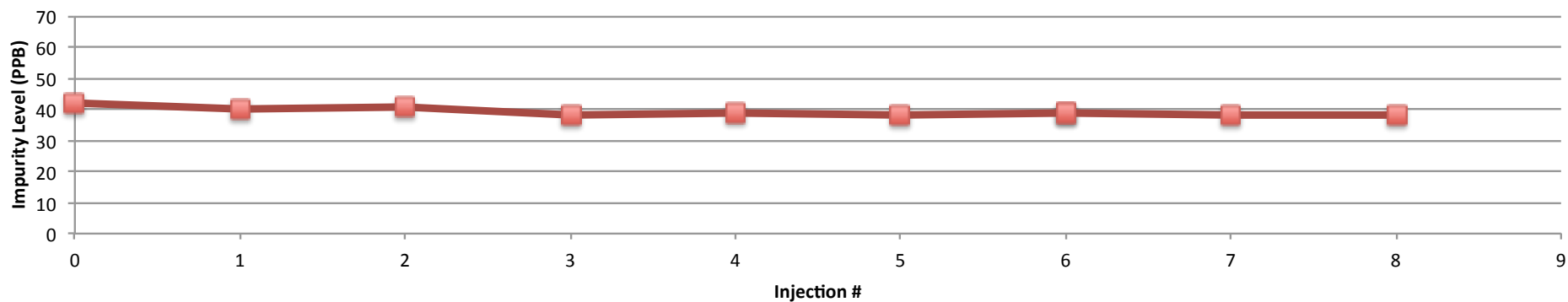
Quenched amplitudes, from WArP



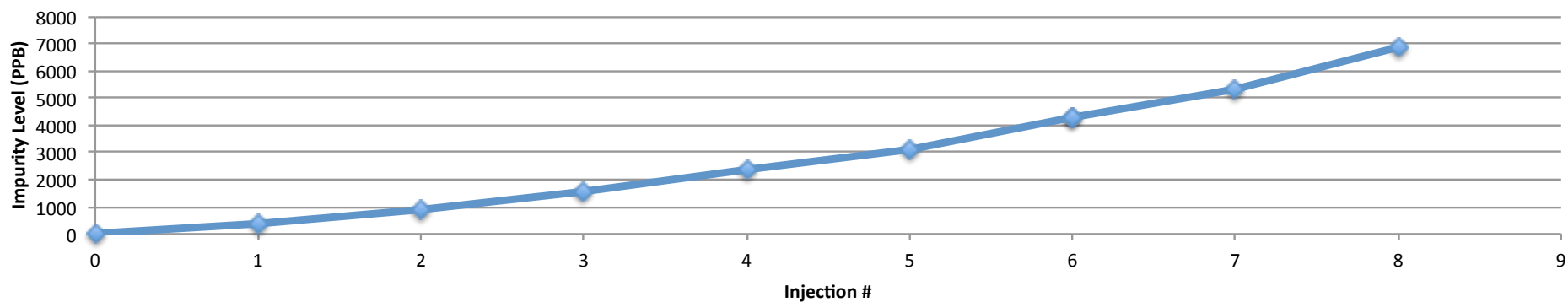
Little quenching of
singlet in 1-10ppm
range

O2 and N2 contamination as a function of injection

O2 (G)

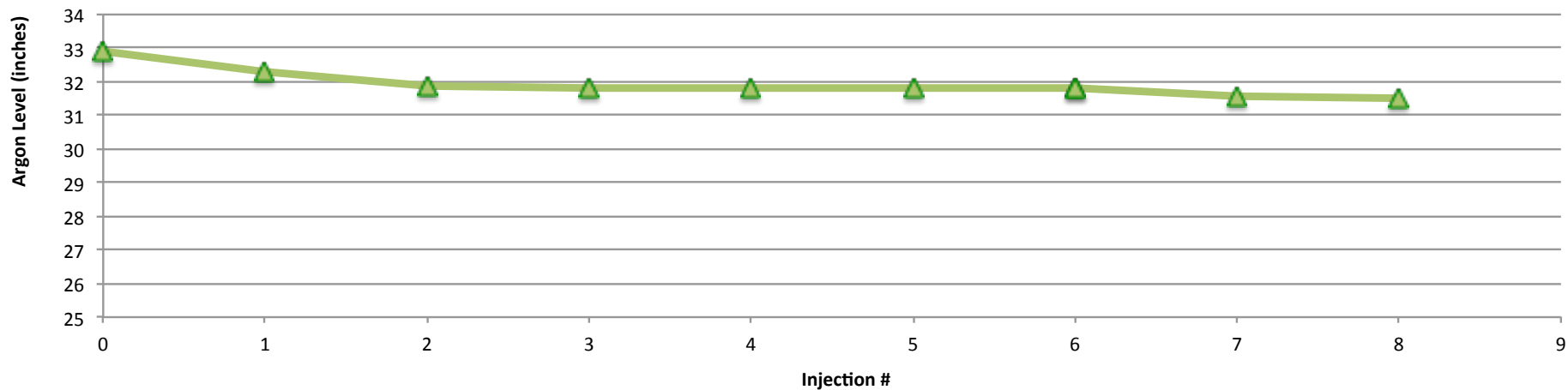


N2 (L)

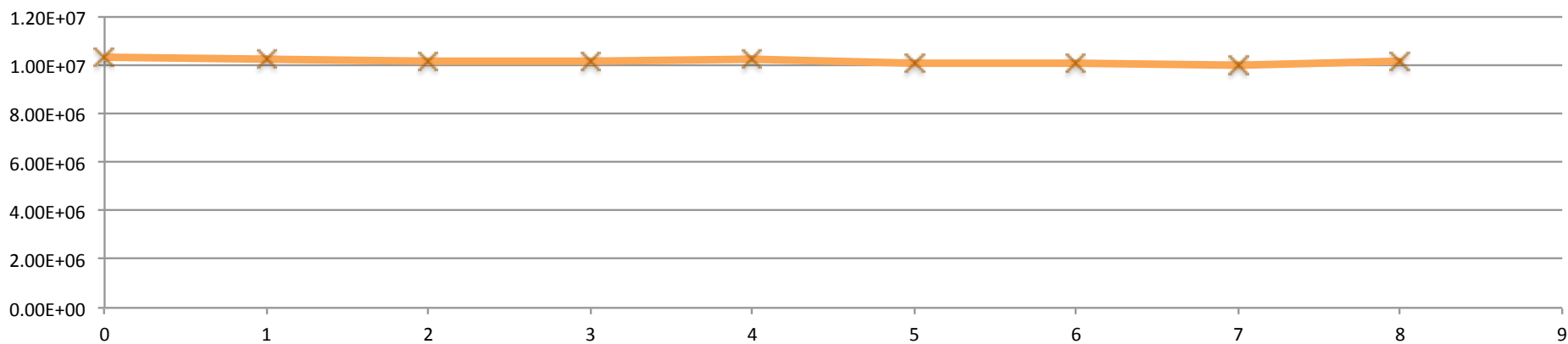


Level from monitor and gain from SPE measurements

Level

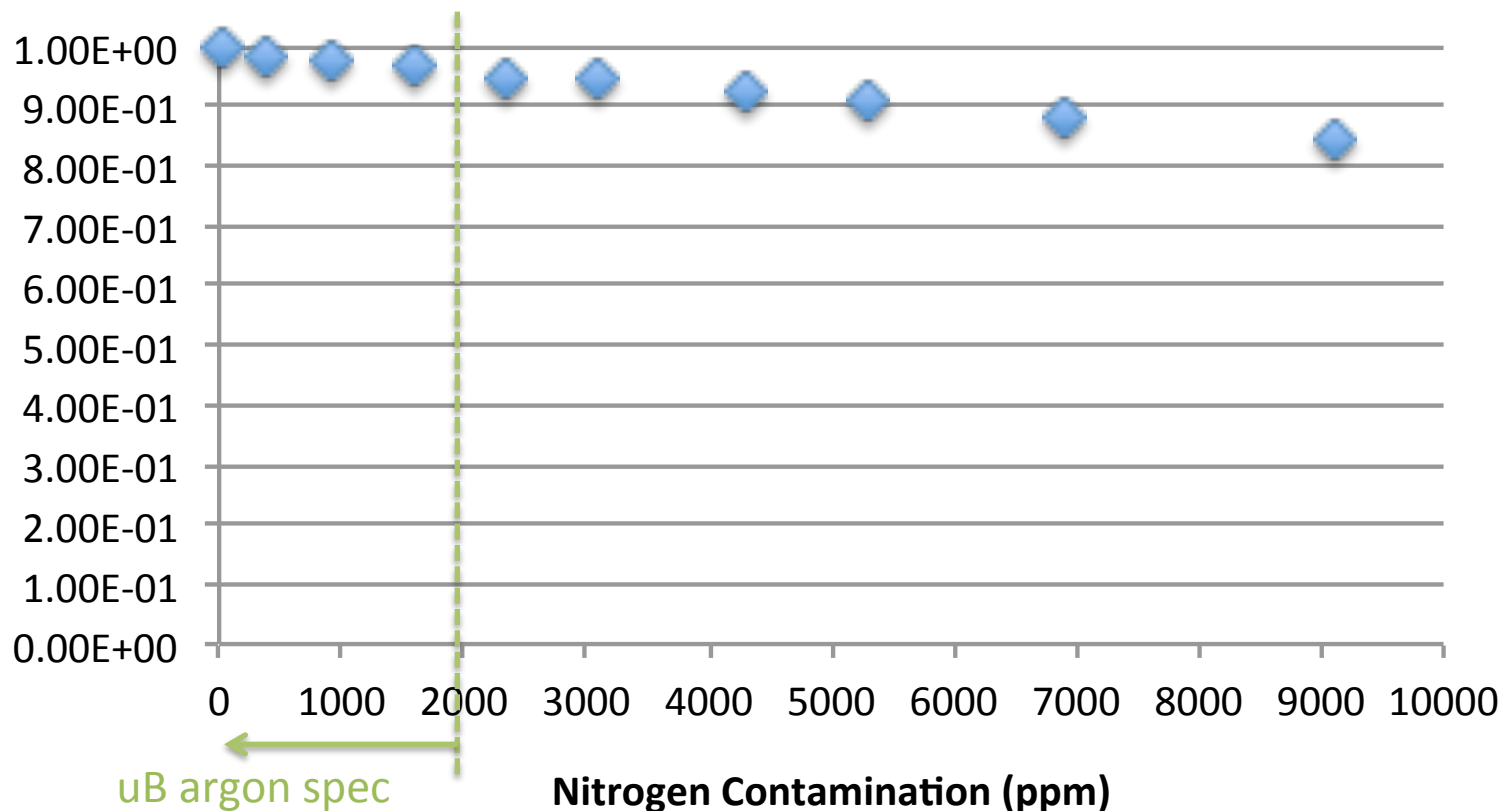


Gain



- Source is placed at $\sim 40\text{cm}$.
- N₂ Injections made as per usual with the pressurized gas canister
- We take the mean alpha pulse area in first 50ns, normalized to the mean SPE pulse area for each point.
- These numbers can be used to give an upper limit on N₂ absorption per cm
- Until we have the data with the other source position + some more subtle analysis, this is only an upper limit on N₂ absorption rather than a measurement of it.
- As long as we can solve some of the other outstanding problems in time, we can measure both quenching and absorption separately in the prompt alpha peak.

Relative Prompt Alpha Yield



Effective Attenuation per cm

